

this type of horticultural enterprise. Mr. Edward A. Murray, a graduate student of Pennsylvania State University, spent three months examining living and herbarium collections of the maples.

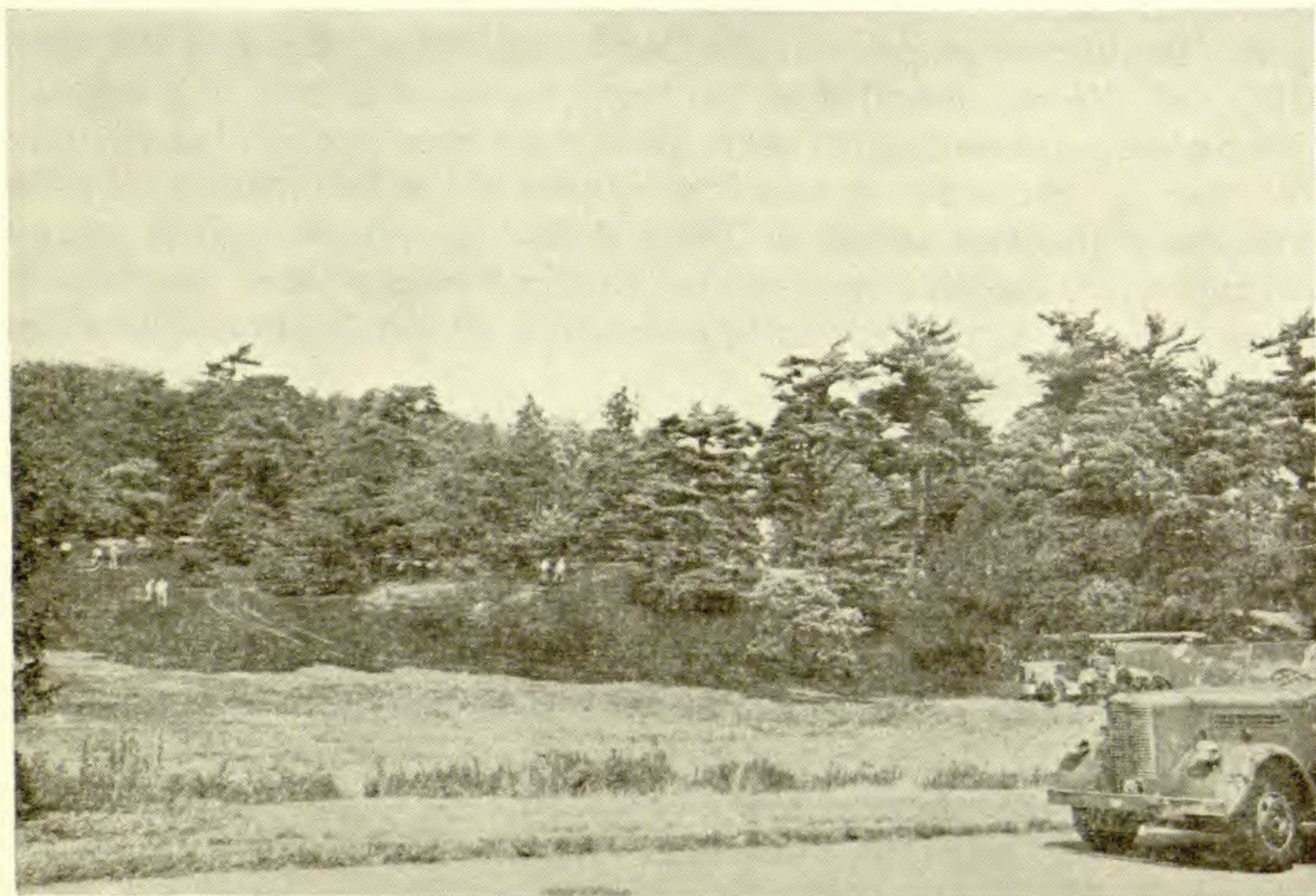
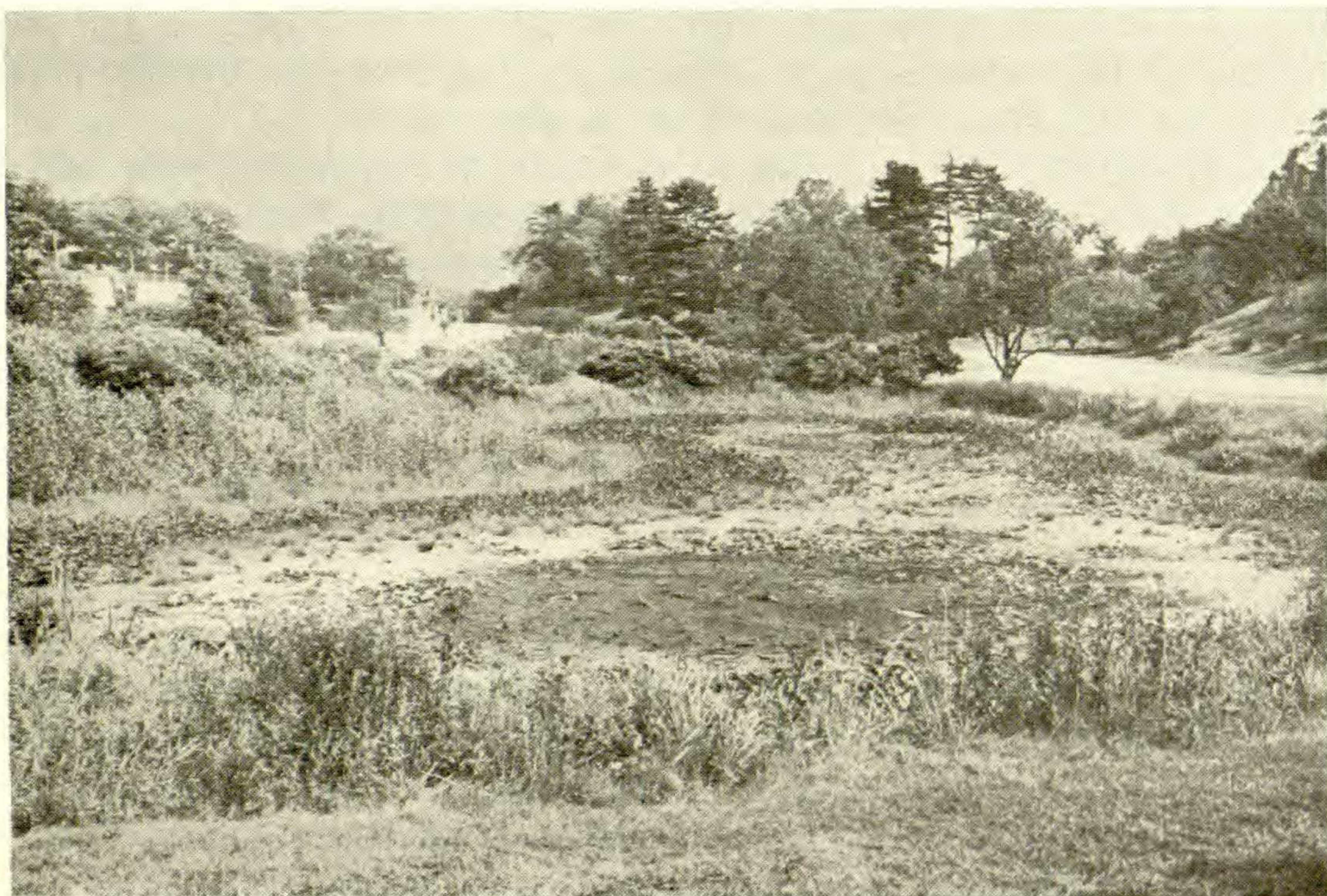
We record also the departure of Dr. Lalit M. Srivastava, who held a Mercer Research Fellowship for three years, and of Dr. Shirley A. Graham, who worked for a year on the project of the Generic Flora of the South-eastern United States.

Honors and assignments came to various members of the staff during the year. Mr. Alfred Fordham was appointed to the research committee of the Massachusetts Nurserymen's Association and to the cultivar testing committee of the International Plant Propagators' Society. Mr. Peter Green was elected secretary for a five-year term at the meeting of the International Association of Botanic Gardens. Dr. Howard was reappointed to the board of the Division of Botany of the International Union of Biological Sciences as a representative of the Section of General Botany. He serves as past President and a member of the board of the International Association of Botanic Gardens and as a council member of the Association for Tropical Biology. Dr. Karl Sax, Professor *emeritus*, served as Sigma Xi lecturer during a portion of the year, as visiting professor of genetics at Cornell University in the fall of 1964, and as Research Associate on a Public Health Service grant at the University of Georgia during the winter trimester. He was awarded an honorary degree of Doctor of Science, at Commencement exercises, in June, from the University of Massachusetts. Dr. Bernice Schubert continues as a member of the Editorial Board of the Bulletin of the Association for Tropical Biology. Dr. Carroll Wood was reappointed to the Subcommittee for Family Names of the Committee for Spermatophyta at the Nomenclature Section of the X International Botanical Congress at Edinburgh.

Dr. Wyman was elected President of the Horticultural Club of Boston. He continues as a Director of the American Horticultural Society and as chairman of its Awards Committee. He is a member of the organizing committee for the XVII International Horticultural Congress to be held in Maryland in 1966, and chairman of the "amateur section" of that Congress. During the year Dr. Wyman was honored three times for his horticultural writings. The International Shade Tree Conference awarded him an honorary membership and plaque in appreciation of his interest in promoting the planting and preservation of shade and ornamental trees. The National Council of State Garden Clubs presented him with a certificate of merit in recognition of distinguished service in promoting literary horticultural interest. Finally, the Garden Club of America Medal of Honor was awarded to "Dr. Donald Wyman, Horticulturist of the Arnold Arboretum of Harvard University, whose energy, ability and contributions to horticulture are outstanding."

Horticulture:

The successful growing of plants in New England is becoming dependent on an apparently decreasing summer rainfall. Although mention



The summer of 1964 was exceedingly dry. ABOVE: The largest pond along the Meadow Road in the Arboretum completely dry. BELOW: The Boston Fire Department assisted the staff in extinguishing a fire in the dry grass and the conifer collection.

has been made of the drought conditions in previous reports, the cumulative effect of successive summers deficient in rainfall are now conspicuous and serious. Three of the first four months of the calendar year 1964 exceeded the expected or mean rainfall by 10 per cent, but seven of the

following eight months were deficient. May, June, July, and August, which should average 13.36 inches of rainfall, produced only 5.95 inches in 1964. In fact, water was carried continuously in tank carts between June and November. Several severe fires were caused by carelessness and vandalism. The fall planting program was considerably restricted and was completed only in areas easily reached with water. The year 1965, to the date of this report, has been deficient in rain; however, the prevalence of cool weather with temperatures well below normal, has been of some aid in reducing loss of plant materials.

The flowering season of the spring of 1965 was outstanding for crab apples, lilacs, and rhododendrons and much below average for cherries, azaleas, and dogwoods. Records of flowering density and dates of the crab apples have been kept for over a decade; this spring produced the heaviest recorded flowering. As it was also the flowering year for crab apples which are alternate-flowering types the display was superb. A cool dry spell kept the blossoms for a long period, and there appears to be excellent fruit-set. As it was also the best recent flowering season for lilacs, Lilac Sunday was enjoyed by a large number of visitors. In contrast was the poor flowering of most azaleas, the Ghent hybrids being the sole exceptions. In addition, there was a large amount of dead wood in the azaleas which can be attributed to the dry summer of 1964.

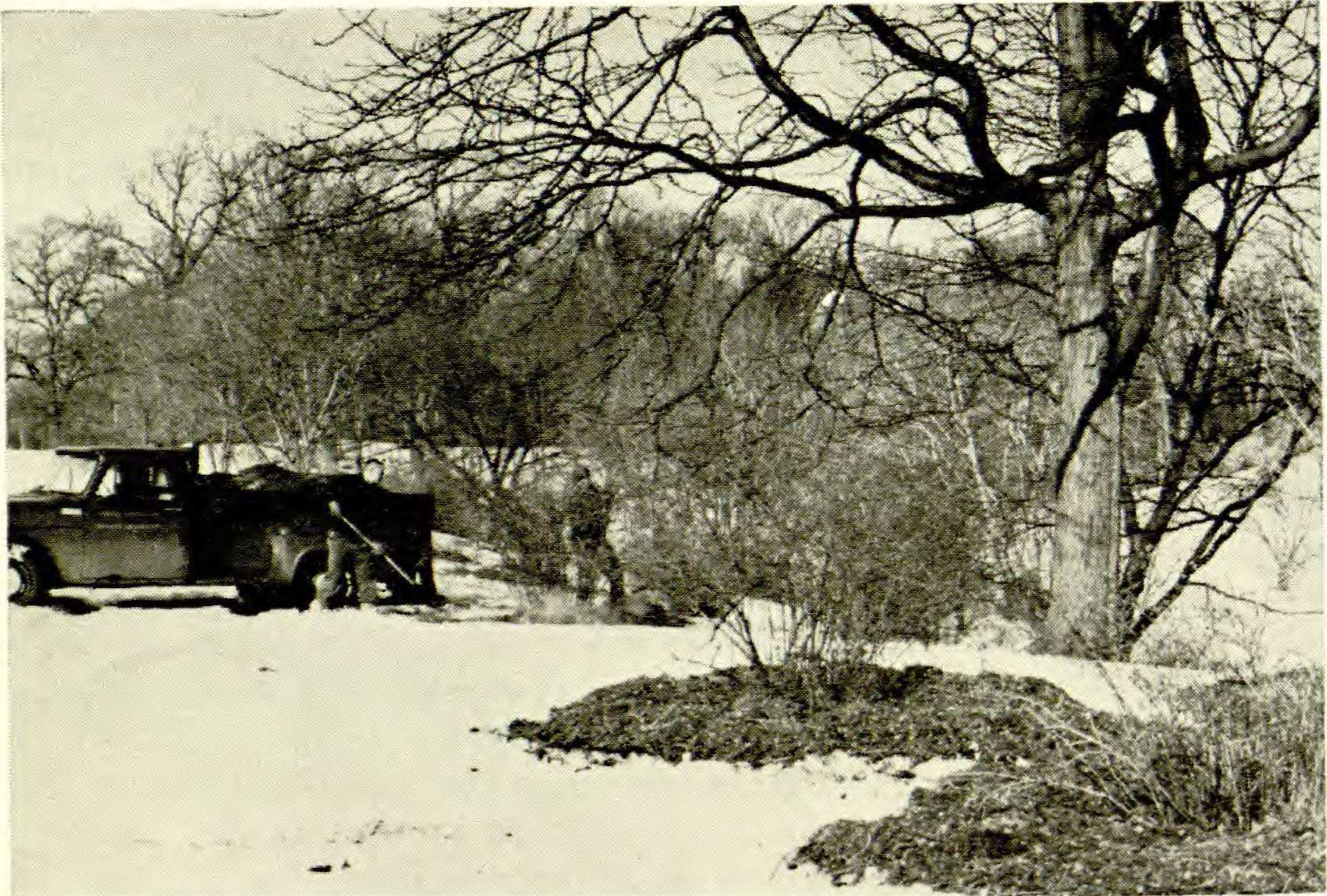
The Department of Parks and Recreation of the City of Boston completed the roadway to the top of Peter's Hill during the early summer. This paved turnaround area provides a fine view of Boston as well as a good location for demonstrating the relationship between soil types and forest tree vegetation in the Arboretum and on adjacent properties, and for indicating the area of the land composing the shoulder of the Boston basin.

During the spring months Mr. Seth Kelsey was retained as a landscape consultant in connection with certain problems and problem areas within the Arboretum. In accordance with his suggestions, preliminary work is under way in some areas of the grounds, including a section of wet land across from the Administration Building where a grove of *Metasequoia* has been planted, and an area of shrubbery around Bussey Hill which has been reduced to allow better vision and to develop a better display of ground cover plants.

A preliminary effort has been made in cooperation with the City of Boston to clean and grade a triangular plot of land isolated when Route 1 (Centre Street) was relocated. The excellent varieties of flowering crab apples on the land, which could provide a spectacular approach to Boston from the south, make the additional work and fencing seem justified.

A project suggested for participants in the Job Corps training program proposed for the City of Boston is the reconstruction and repainting of the fence surrounding the Arboretum. In anticipation of this program, old vines growing on the fence were severely pruned during the late winter months.

In the vicinity of the greenhouses, two new beds were established as



Winter work for the ground crew. ABOVE: Composts and manures may be spread effectively at any time of the year. BELOW: Slats for the greenhouse receive protective coats of paint in the attic of the Administration building on a stormy winter day.

a temporary location for genetic dwarf conifers. The plants in these beds have been mulched with a deep layer of crushed rock; a permanent location for them is planned around the *bonsai* house. Additional espalliered

plants have been established along the chain-link fence bordering Centre Street.

The work of the greenhouse staff includes the receipt and distribution of plant materials; the maintenance and service of collections, experimental and research projects; and educational activities.

The records for the receipt and distribution of plant materials as seeds, propagating material, or whole plants indicate the extent of activities. During the year the Arnold Arboretum staff received 288 shipments of plant materials comprising 1482 units from 39 countries. We sent out 294 shipments of 1314 units to cooperating institutions and nurseries in 17 countries. Much of the material received was collected or selected by Dr. Wyman in the course of a trip through Europe which is still in progress. By visiting nurseries, botanical gardens, and research organizations, as well as private gardens, many new plants worthy of introduction and trial in the United States have been located. The acquisition of this material, its shipment and acceptance at ports of entry, and its subsequent quarantine status involve the cooperation and kindness of many individuals and organizations; we are most grateful to each of them. The full amount of material being introduced as a result of Dr. Wyman's trip will be indicated in the annual report of the next fiscal year. Already the number of taxa received suggest that this will prove to be one of the major recent horticultural efforts.

Material has also come in from a sponsored expedition to the Near East and from the efforts of Mr. Hosmer in Afghanistan.

The distribution of materials from the greenhouse facility is partly in response to requests and partly in continuance of a program of distribution and testing. Hardiness testing programs in cooperation with the universities of Minnesota, Maine, New Hampshire, and Vermont and with Iowa State University continue, with the resulting establishment of new ornamental plants in areas previously considered unsatisfactory. In another program, plants are regularly contributed to the North Central Regional Hardiness Testing Program of the United States Department of Agriculture in Ames, Iowa. Plants used for research projects at the Arboretum which need warmer climates for continued growth are grown in one of several gardens in Florida which cooperate with us, or in one of the Gulf states, while new preliminary arrangements now permit limited amounts of material to be grown in one of three locations in Puerto Rico.

Requests for material come from many sources and may be general in nature, or specific to fill particular research needs. It was possible this year to supply material for planting around many new University buildings and to fulfill small requests from some other institutions. In response to many requests material has been supplied to various workers for scientific studies. Fifty-seven kinds of seeds were sent to Iowa State University for use in an investigation of plant proteins which react with certain animal blood-groups. Members of the Araliaceae are still under investigation for their cancer-retarding constituents. An investigation of the accumulation and retention of fluorides in plant tissues led to the request

for leaves of members of the Theaceae. Morphological investigation in many parts of the world led to requests not only for specific plant parts but for specimens collected at definite intervals in the development of the flowers or fruits.

During the year 340 taxa were propagated to serve as replacements on the Arboretum grounds; 107 taxa were processed to provide staff members with material for taxonomic work, teaching, or morphological research. To acquire propagation data for experimental work of the greenhouse staff 76 taxa were processed during the year. Experimental work on the propagation of witches' brooms on conifers continues and shows considerable horticultural promise.

Progress continues on the checking of identification of plants on the grounds and in the preparation of new labels where they are needed. Preparation of specimens from the plants on the grounds not previously represented in the herbarium of cultivated plants has been carried on actively, and additions to the collection of cultivated specimens have also been received from England and Switzerland, together with large collections for identification from Australia, Bermuda, Brazil, Iraq, and Trinidad, as well as the United States. Selected specimens from the greenhouse collections of Cornell University and of Smith College, for which we are grateful, were also made available. An interesting collection of specimens of cultivars of *Erica* and *Calluna* was obtained from the Heather Garden of Mr. H. Copeland, near Chatham, Massachusetts.

Dr. Dudley's introductions of many taxa of *Alyssum* survived the winter in field plantings at the Case Estates and suggest that such taxa from the Mediterranean and the Near East may be of horticultural value in New England. Mr. Green continued his work on *Jasminum* under cultivation. Many of his recent introductions, now released from post-entry quarantine, have been distributed to other gardens for testing. In connection with Mrs. Lily Rudenberg's cytological studies on our *Loniceras*, Mr. Green checked the identification of much of the collection and made a detailed study of *Lonicera tatarica*, its relatives, and the associated mass of hybrids. A coordinated program of testing *Lonicera* has been planned with the horticulturists of the Moscow Botanic Garden. Seeds of many clones of *Lonicera* have been supplied from localities throughout the Soviet Union; comparable observations and data will be sent from this country.

A registration list for *Weigela* has been completed by Dr. Howard, and lists for *Lantana*, *Philadelphus* and *Sambucus* are in preparation.

Case Estates:

An Open House was held at the Case Estates in Weston on Sunday, May 16th. Several staff members were present to explain the work in progress and to answer questions. The number of individual visitors and organized groups at such events has increased. To explain better the functions of the several plantings and exhibits and to reduce the demands on the staff, a brochure was prepared which, through numbers and arrows,



Special plantings as educational exhibits at the Case Estates of the Arnold Arboretum in Weston, Massachusetts. ABOVE: A demonstration planting of *Lilium* species and cultivars established with the cooperation of the New England Lily Group of the North American Lily Society. BELOW: Perhaps the best known of the plantings on the Case Estates, the ground-cover plant test plots. Periodic reports of the observations made on these plantings are reported in issues of *Arnoldia*.

directs a self-guided tour. The leaflet has proven popular and has much increased both the number and the interest of the visitors. Engraved labels on all of the display plantings helped to distinguish the plantings which are experimental from those of established horticultural value.

Several of the special collections of cultivars have been increased through the generosity of individuals and societies or organizations. The *Hosta* collection now contains the best clones selected by Mrs. Frances R. Williams, of Winchester, Massachusetts. Additional named clones received from the Botanic Garden in Uppsala, Sweden, serve to document the monographic work of Dr. Nils Hylander. Through the kindness of Sir George Taylor, Director of the Royal Botanic Gardens, Kew, selected clones of English origin have been received for trial. Dr. K. J. W. Hensen assisted in supplying the clones of *Hosta* from the collections of the Landbouwhogeschool in Wageningen which documents the registration list of cultivars published in the Netherlands. The combined collections of over 140 clones will permit a cross evaluation of hardiness and horticultural characteristics of plants originating in Europe and in America.

The *Hemerocallis* collection has been increased by additional taxa donated by members of Region 4 of the American Hemerocallis Society. This collection is being developed to show students and the public the characteristics of the species, the variations which are the basis for horticultural classification and selection, and the best of the cultivars.

The *Lilium* collection created exceptional interest locally as it came into flower. Dr. Wyman has maintained records of the flowering periods and related data which were published in an issue of *Arnoldia*. The international requests for this publication indicated the very wide interest in lilies. We acknowledge with appreciation the gift of 400 bulbs of *Lilium superbum rubrum* 'Uchida' sent in furtherance of international friendship and as an example of the breeding and selection work being done in the Kanagawa Prefecture of Japan. The size of this gift has permitted the staff to plant these bulbs in many locations, using different mulches.

On the basis of our observations on the small-tree plot Dr. Wyman has assisted a special committee of the Wire Utility Services of New England to revise their booklet "Trees in your community."

The tree-growth test-plantings of the Cabot Foundation in Weston were re-examined during the year by Dr. Scott Pauley, then cleared of volunteer seedlings and dead trees and subjected to selective pruning. The growth rates of these plantings are compared at regular intervals with plants of the same clones and taxa grown in Jamaica Plain, Petersham, and Quabin, Massachusetts, and in Minnesota.

Herbarium:

Considerable progress was made in curatorial work involving the herbarium quarters, the insertion of mounted materials, and the organization of unidentified collections formerly in storage. The fourth floor of the Administration Building in Jamaica Plain, where part of the herbarium of cultivated plants is housed, was cleaned and repainted. A well-covering

placed between the second and third floors allows better heat control and reduces the noise of activities elsewhere in the building. The collection of unworked and duplicate collections was reorganized for greater efficiency. Work continues on the organization of cultivated plant specimens into the geographical areas where they are grown, on the recognition and marking of type specimens, and on the annotation of specimens representing taxa considered in recently published monographs.

During the year 20,395 specimens were mounted and added to the herbarium collections in Jamaica Plain and Cambridge, bringing the total number of sheets to 806,279. During the year 10,167 specimens were received, the greater portion by exchange.

During the past year staff members and students requested or received for identification 4,317 herbarium sheets representing 95 loans from 36 institutions. The staff filled loan requests for 138 loans to 72 institutions and sent out 14,713 specimens.

Dr. Brizicky completed his studies of the Tiliaceae and Elaeocarpaceae for the Generic Flora of the Southeastern United States and has turned his attention to the Sterculiaceae represented in that area. Studies on the Cistaceae and Vitaceae were the result of earlier studies for the flora project.

Dr. Dudley is continuing studies on the genus *Alyssum*, segregates, and relatives and is preparing a treatment of the group for the *Flora Iranica*.

Dr. Ferguson completed studies of the families Dipsacaceae, Valerianaceae, and Caprifoliaceae in the southeastern United States and has turned his attention to the Cornaceae of the area.

Mr. Green completed work on his collections from New Caledonia, Lord Howe Island and Norfolk Island. Many of these collections were studied at the herbaria of Kew and the British Museum during visits associated with the botanical congress in Edinburgh.

Dr. Hartley began a study of *Zanthoxylum*, including *Fagara* and *Blackburnia*, in the Malesian area. His large collections from Papua and New Guinea have arrived, and the nearly 3700 numbers are being prepared for identification.

Dr. Howard has continued his studies of the plants of the Lesser Antilles, devoting considerable attention to old unidentified collections from the French Islands which have been loaned by the Muséum National d'Histoire Naturelle, Paris. The collections of Dr. and Mrs. Richard Wagner in Puerto Rico include many new records and several new species. Preliminary plans have been prepared for a critical study of the environment, composition, and biology of the mossy forest zone in the Luquillo Mountains.

Dr. Hu made trips to various European herbaria before and after the botanical congress in order to photograph and examine many of the type collections of species of *Ilex*. She has also completed and submitted for publication a bibliography of the Compositae of China.

Dr. Nevling continued his studies of the Thymelaeaceae. He has verified the hybrid origin of *Daphne* \times *mantensiana*, as suggested by earlier

studies, and completed a treatment of the Brazilian genus *Funifera*. Studies of *Dirca* and *Schoenobiblus* are in progress. The genera *Decumaria*, *Pileostegia* and *Schizophragma* are being examined for both their horticultural and botanical interest.

Dr. Perry, although officially retired, has completed the preparation of a manuscript on the medicinal plants of southeastern Asia and has turned her attention again to the Arboretum material collected in New Guinea by Dr. Brass and others.

Dr. Schubert had the opportunity of examining type specimens and other important historical collections of the genera *Desmodium*, *Dioscorea*, and *Begonia* during visits to herbaria at Edinburgh, Kew, and the British Museum.

Dr. Wood has continued his direction of the work toward completion of a Generic Flora of the Southeastern United States. The extensive list of family treatments already prepared is scarcely indicative of the important background work also accomplished in the preparation of bibliographies, lists of abbreviations, glossaries, and the supervision of the preparation of the illustrations. Dr. Wood also studied types and critical material of the genus *Hedyosmum* at British and European herbaria before the botanical congress.

We are pleased to have had many visitors who examined material in their special groups for varying periods of time. These studies involved not only the herbarium and library, but also the special collections of fruit, wood, pollen, and the living collections in Jamaica Plain and Weston. Among others, Dr. Quentin Zielinski, of Oregon State University, used almost all the facilities for his work on the genus *Pyrus*; Dr. Howard Scott Gentry, of the U.S. Department of Agriculture, started an examination of our material of *Agave* and studied the pertinent literature, as well as the special collections and notes prepared by Mrs. McKelvey. Dr. R. J. Williams, of the CSIRO of Australia, consulted with Dr. Schubert regarding *Desmodium* and other Leguminosae and checked specimens and distributions in the herbarium before continuing his trip for field work in South America. Dr. Stauffer, completing a trip around the world devoted to the study and collection of material of the Santalaceae, spent a month studying and annotating our material. Dr. Philip Munz used the herbarium for an extended period in connection with his work for the new edition of *Hortus* being prepared at the Bailey Hortorium of Cornell University. Mr. Dieter Wasshausen, of the United States National Herbarium, was one of the visitors especially interested in the methods and procedures used in the herbarium.

The herbarium and library are the depository for many valuable special collections. We are happy to acknowledge a particularly interesting gift this year of the manuscripts, specimens and fragments, and photographs compiled by the late Dr. Henning Horn af Rantzien in his studies of *Potamogeton* and other aquatic flowering plants. This material, the gift of his widow, Mrs. Anna Horn af Rantzien, will be available for the study of visiting scholars.

Library:

Much of the activity of the library staff during the year concerned the organization and evaluation of material received as bequests and gifts, and of older collections needing additional work. Mrs. McKelvey, who knew our library as well as any individual could, enriched it still further by leaving 280 of her books to be added to our collection. Her earlier gifts of supporting materials to her work on lilacs, yucca, and the Trans-Mississippi West have been acknowledged in previous reports.

Mr. Seth Kelsey, a friend of the Arboretum and a member of the Committee to Visit the Arnold Arboretum for many years, moved from the Boston area and was forced to dispose of the records of his father, the late Harlan P. Kelsey. Since much of the material concerns the development of horticulture in New England, the staff of the Arboretum has accepted this collection for study and organization prior to appropriate disposition of parts of the material on national parks, city planning, standardized plant names, the American Horticultural Society, and the Arnold Arboretum. Of particular value and interest to the Arboretum will be the extensive correspondence of Mr. Kelsey with Charles Sargent, E. H. Wilson, and many other members of the staff.

We are grateful to Mr. H. H. Richardson, to Mr. Malcolm A. Milne, and to others who do not wish to be named for large collections of books.

Many books and pamphlets on plant morphology and plant anatomy which were transferred in 1933 to the library of the Biological Laboratories have been reincorporated in the library collections of the Arnold Arboretum.

Considerable effort has been devoted to reorganizing the reprint collection of the late Professor J. H. Faull. The system of classification which was useful to the compiler has not proven to be a practical one for a modern library, making a reorganization essential. Many of the reprints concerned with forest plant pathology, accumulated while Professor Faull was on the staff of the University of Toronto were offered to the Shade Tree Research Laboratory of the University of Toronto and were gratefully accepted.

Miss Stephanie Sutton has undertaken the task of organizing the material and correspondence concerning the history of the Arnold Arboretum. We are requesting from other institutions "xerox" or other copies of letters of historical interest to and from Arboretum staff members. Mr. Henry de la Montagne, of the New York Botanical Garden, has been instrumental in supplying copies of correspondence from that institution, and his assistance is deeply appreciated.

During the year 647 bound volumes were added to the library of the Arnold Arboretum bringing the total to 52,864. Two hundred and forty volumes concerning horticulture were deposited in the library in Jamaica Plain. We acknowledge the assistance of Mr. Theodor Mayer, of Montreal, Canada, for his interest and help in adding to the Arboretum holdings of volumes on the genus *Rosa*. Reprints and pamphlets totalling 450 were added to files of monographs and author separates making a total of

20,274 items so catalogued. Many of the older reprints were placed in permanent covers with typed indices.

The annual published increment of 3000 cards was added to the *Card Index of American Plants* issued by the Gray Herbarium. Sixteen hundred title cards were added to the *Index to American Botanical Literature* published by the Torrey Botanical Club. Number 20 of the *Index Nominum Genericorum* series was received and incorporated. Over 1400 index cards appropriate to the Rehder index of cultivated plants were prepared and inserted in the series.

Mrs. Swarten has continued her work on the preparation of standardized abbreviations for bibliographic citation. She is working with Mr. Green and Dr. Howard in the compilation of literature citations used in the registration lists of cultivar names being published. To this index will be added citations for nurseries and nursery catalogues which have proven to be sources of cultivar names. Publication is expected in this calendar year.

Comparative Morphology:

Professor Bailey is continuing his investigations on the primitive leaf-bearing Cactaceae under an extension of his grant from the National Science Foundation. At present he is concerned with the occurrence of "protein bodies" in *Pereskia* and *Pereskopsis* and with the formation of water-soluble anisotropic bodies in dehydrated leaves of these genera. Papers numbered XII and XIII of the series dealing with these significant groups have been published during the year.

Professor van der Schijff, since the first of the year, has been working in this laboratory. He has undertaken an investigation of the unusual growth characteristics and subterranean stem development in many of the Leguminosae from arid regions of South Africa. Seeds of *Elephantorrhiza elephantina*, *Erythrina burkei*, *Erythrina humeana*, and *Erythrina zeyheri* were started in the greenhouses of the Arboretum and showed the same characteristics of shoot dormancy exhibited by these plants in the Southern Hemisphere. In its native habitat *Elephantorrhiza elephantina* may be regarded as a noxious weed because of the persistence of its enlarged subsurface base. A study of the seedling development of all four species will yield information about the origin of the characteristic elephantine stem forms of these plants.

Dr. Howard has continued his studies of nodal and petiolar anatomy with attention devoted to securing information concerning families of plants not well represented in the available flora, or families of recent description, and genera regarded as having questionable affinities.

Cytology and Genetics:

Dr. Sanders has continued her studies of the cytology of various colchicine treated lines of *Sorghum*. The investigation involves diploid mutants obtained from both diploid and tetraploid seedlings. Chromosome counts have been made for most of two hundred untreated and